

Measuring the Effectiveness of Oceanography Courses

C. Cudaback
North Carolina State University
at
University of British Columbia
May 10, 2007

Dr Wieman issues the challenge

Non-majors are under-served.

Students find science boring and irrelevant.

Introductory physics and chemistry courses
make attitudes worse.




Ocean Literacy (defined by COSEE, 2005)

- understanding
- communication
- decisions

Levels (NEETF report to NOAA, 2005)

1. Environmental awareness
2. Small personal steps
3. Environmental literacy

Learning Objectives: 2 x 2 Matrix

	Ocean Science	Ocean Stewardship
Content	understand ocean science	understand human impacts on the ocean
Attitudes	perceive science as a useful tool	feel responsible for ocean conservation 

How to measure attainment of objectives?

Educational Research - new vocabulary

Survey Instrument =
tool to measure knowledge or attitudes

Validity = accuracy; hard to measure

Reliability = precision; use statistics

Cognitive Domain = content knowledge

Affective Domain = attitudes

A Valid Survey Instrument measures what students are thinking ... it's hard to do

- 1) Content Validity
Asking correct questions?
- 2) Construct Validity
Asking questions correctly?
- 3) Criterion - Related Validity
My results match others?

Question:
Did dinosaurs ever coexist with humans?

<i>Y/N</i>	<i>Thought Process</i>
N	Dinosaurs went extinct 65 million years ago, during a mass extinction caused by an asteroid impact. Humans have only been around ~5 million years.
N	"Old" appearing dinosaur bones were buried by God, about 4000 years ago, to test our faith in His revealed world. Dinosaurs never existed.
Y	"Jurassic Park" was a documentary, right?
Y	Current paleontological research classifies birds as living, feathered, dinosaurs. (thanks to J. Libarkin)

This construct is invalid.

Science Content Quadrant (scientists teaching)

Objectives

Teaching



Learning



Research

1. cover material
2. students understand concepts
3. students pass exams
4. Bloom's taxonomy
5. educational research

State of the Research

Geosciences Concept Inventory

J. Libarkin et al

- dozens of faculty, 100's of students, 7 years
- validation: qualitative => quantitative

Ocean Literacy Survey

C. Cudaback ... others?

- just starting, a few students helping out
- validation underway

Stewardship Content Quadrant

Academia

- instructors Vs texts

Other Sources

- conservation organizations
- media - LA Times, Nat. Geographic, Discovery

... inquiry guided learning!

Science Attitudes Quadrant (science is relevant and useful)

- implicit in many science courses
- good attitude => good content learning

Formal educational research

- language: domains, validation, reliability
- instruments: VNOS, VASS, CLASS

Stewardship Attitudes Quadrant (I should look after the ocean)

Should it be part of intro science courses?

Public opinion surveys by polling firms

- for education/conservation
- large samples: eg 1500 phone survey
- instrument validation rarely reported
- no teaching/learning

Measuring Ocean Literacy: Data Collection

Spring 2006: Qualitative Content Survey

- my lecture, 120 students
- E. Knowles distance, 20 students

Fall 2006 & Spring 2007

Quantitative Attitude Survey

- honors, 12 students
- FYI, 16 students
- E. Knowles, 20 students

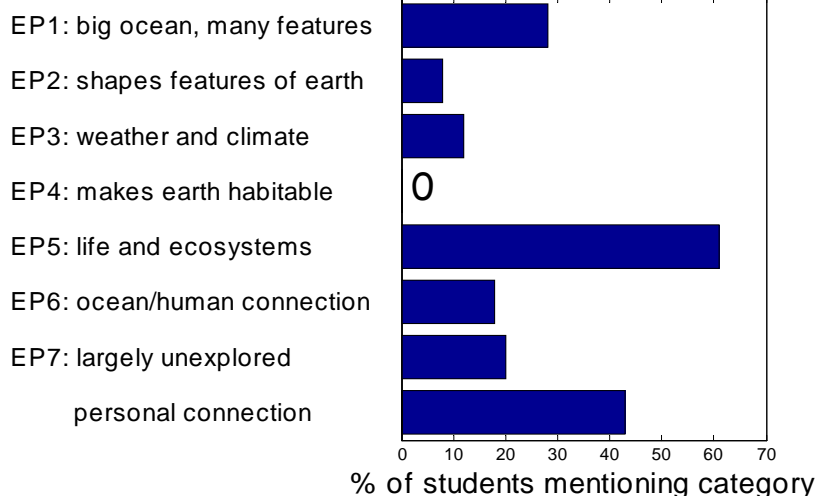
Qualitative Data - Student Background

What interests students?

Where have students learned about the ocean?

Method: look for patterns in essay responses.

Essay: what interests you about the ocean? Essential Principles from COSEE, 2005



"There is so much that we don't know, and that's very intriguing. We probably know more about outer space than we do about deep-sea ecosystems,"

"It makes my imagination go wild."



Oceans are neither boring nor irrelevant

"Every moment brings something new."

"I feel a type of completeness
I don't feel anywhere else."

"I like the power, energy, motion,
and sounds of the waves."

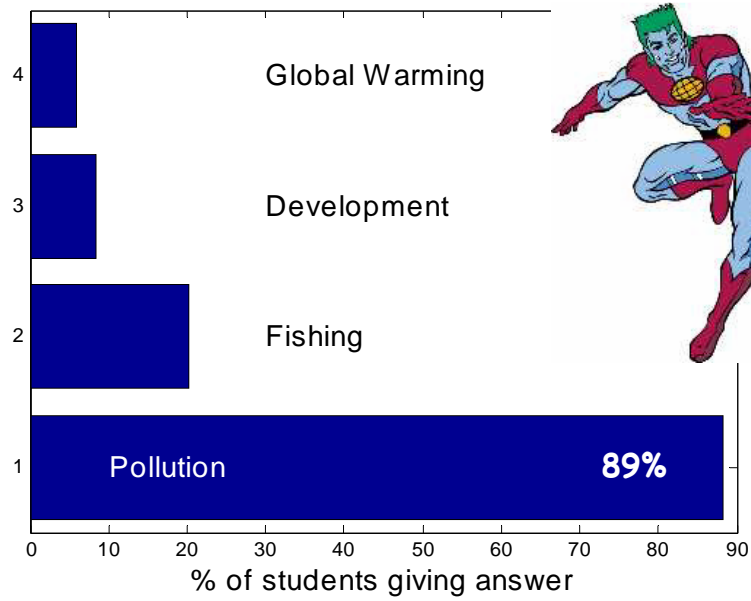
"Mysterious and scary...
beautiful and intriguing."

"The ocean is the last semi-sacred place on Earth,
where humans haven't colonized and totally
demolished the place."

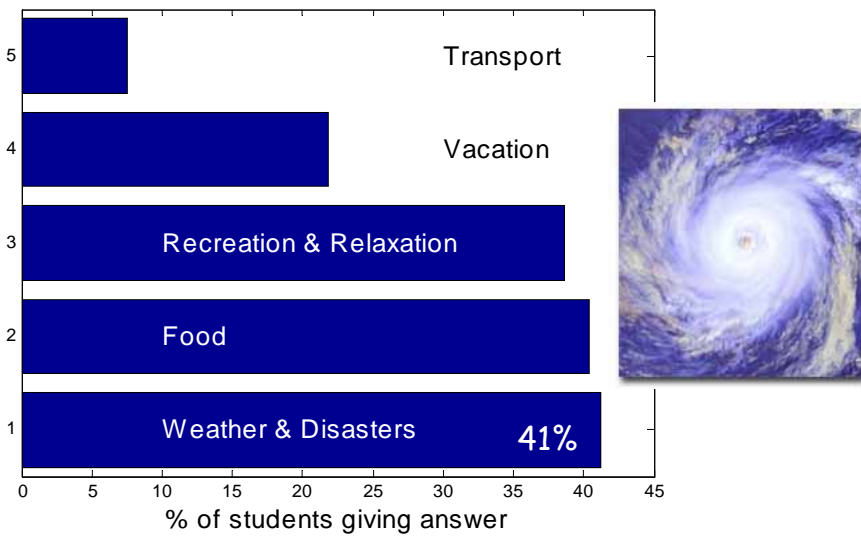


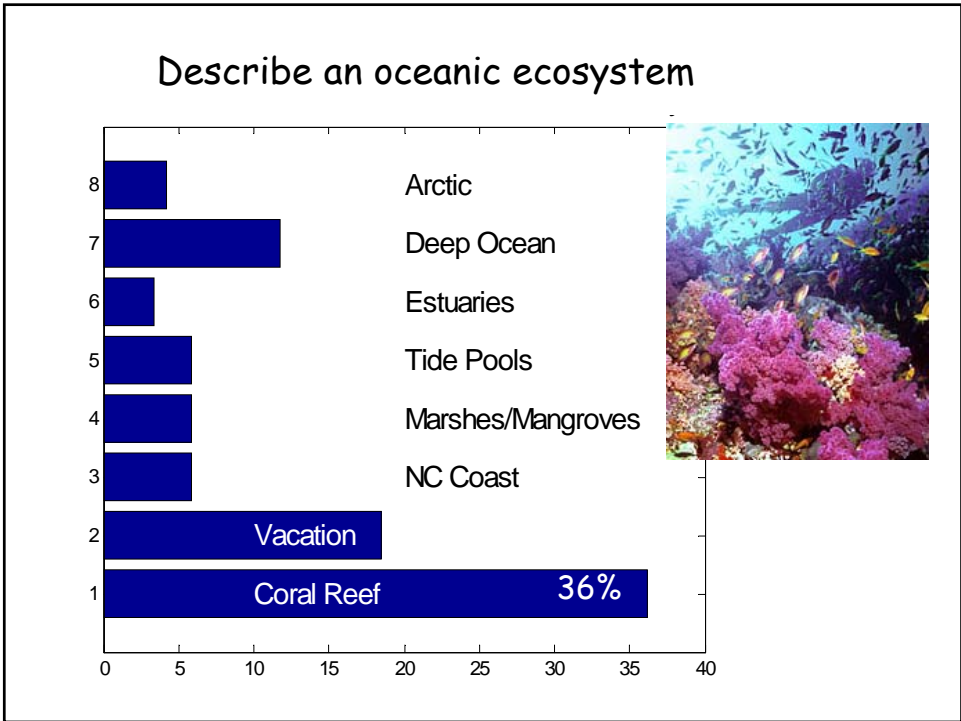
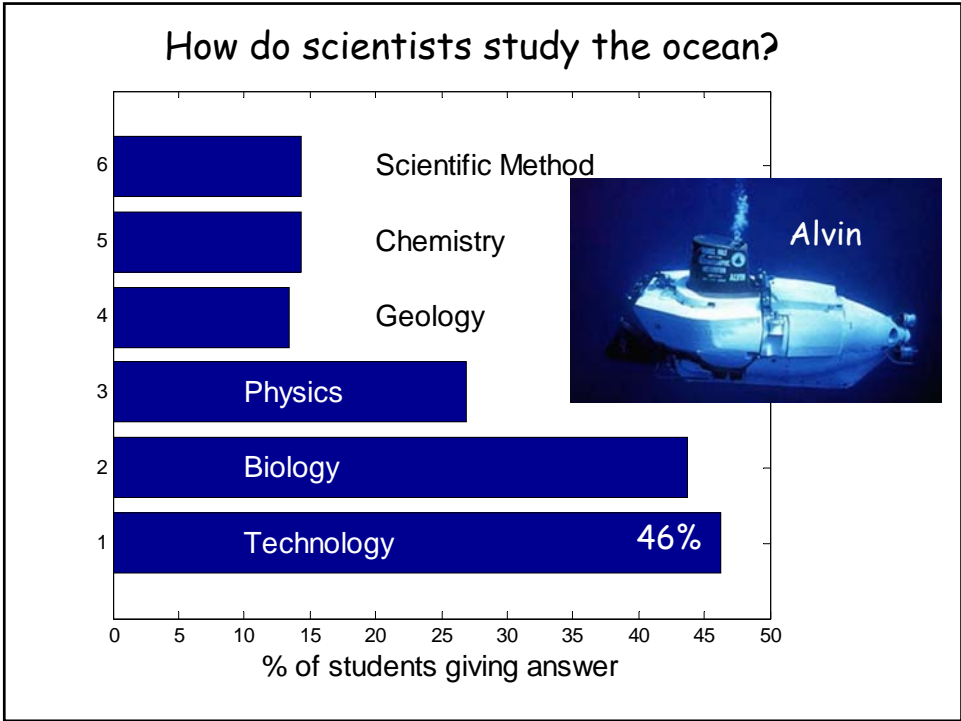
Can teachers channel this passion?

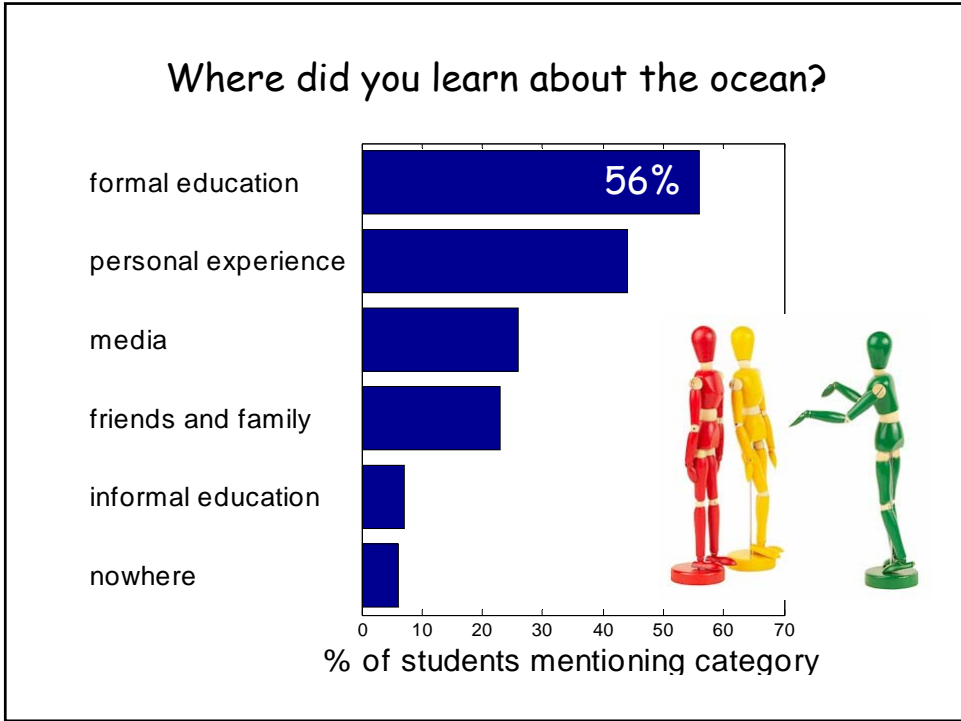
How do your actions affect the ocean?



How does the ocean affect you?







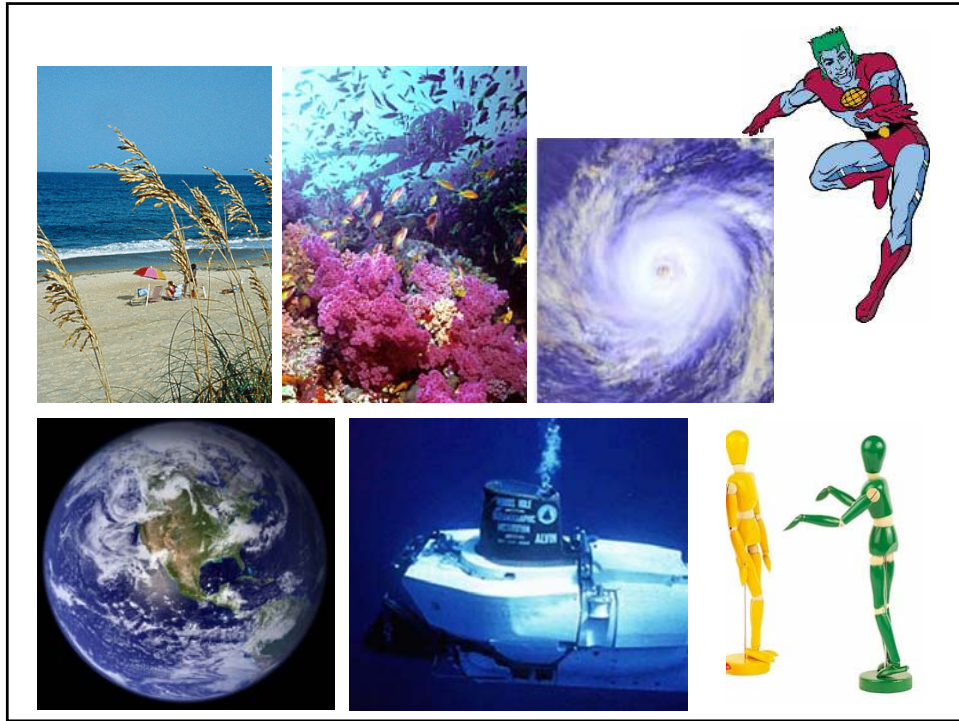
The role of conversation in Ocean Literacy

Pre-class:

"[I want to] impress girls at the beach with my knowledge of why the ocean does what it does."

Post-class:

"It seems like now anytime I hear someone... speak about the ocean, I just want to jump in and explain everything I know."



Quantitative Data - Student Learning

Preliminary Score on 1st version of survey
(n=111)

Topic	Questions
1. Size of the ocean	(4 short)
2. Ecosystems	(essay)
3. Human Impacts	(essay)
4. Nature of Ocean Science	(essay)

Science Content Preliminary Quantitative Results

- ✓ grades and pre/post-class scores are normally distributed
- ✓ t-test reveals significant increase in scores
- ✓ pre, post and increase are correlated with grades
- ✓ E. Knowles post-class scores are correlated with grades
- ✓ on track for developing a valid and reliable instrument

Quantitative Data - Student Attitudes

- combine 3 small classes, total n = 44
- stewardship: AAAS, Ocean Project, Minnesota
- science: CLASS
- confidence that they know stewardship content

Attitudes - Results

1. Most questions, positive attitude, no change
2. Significant improvement on 4 questions
 - my actions have significant effect
 - familiar with regional issues
 - could write letter to congress
 - relate learning to what I know (CLASS)

Summary: Ocean Literacy

- teach science and stewardship
- measure content and attitudes
- pre-class: students passionate about oceans
- post-class: content & attitudes improve

Developing Objectives at UBC

- start with introductory oceanography
- all faculty collaborate using Wiki
- pedagogy & assessments
- organize by scale, topic, level
- D. C. al fine